



SEISMOLOGY  
RESEARCH  
CENTRE

# eqServer

EARTHQUAKE DATA MANAGEMENT SYSTEM

## PRODUCT USER MANUAL



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# An Overview

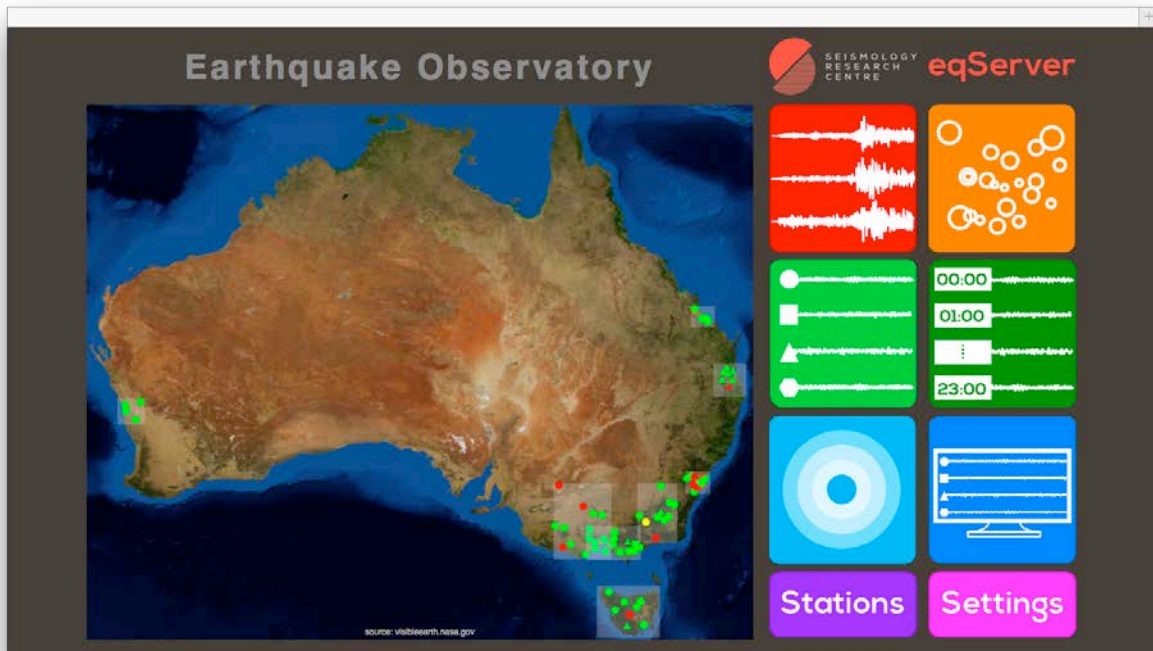
eqServer is a data management system for telemetered earthquake monitoring networks. It is provided as a dedicated appliance that can be connected to your Ethernet network, or it can be provided as a cloud-hosted service. In either configuration, the user interface is via a standard web browser, allowing you to view real-time data, historical data by station or by sub-network, and monitor the state-of-health of an instrumentation network.

eqServer is also an automatic event detection system that will associate activity at several stations and attempt to calculate the location and magnitude of the event, also generating an email notification. This event data can be accessed through eqServer and by using our Quick Quake iPad app.

An SQL database stores all of the station information, map place names, and automatic event location information. If you are using eqFocus, you can connect to this database to add or refine earthquake solutions, using various flags to allow you to filter event lists by quality, magnitude, location, and many other parameters.

eqServer was designed for use with Kelunji seismographs that have traditionally produced meta-data rich seismic waveform files in PC-SUDS format, but eqServer can also accept other data formats such as MiniSEED. eqServer also includes a facility to draw data from SeedLink servers – a data sharing protocol used by some data acquisition systems and by organisations such as IRIS.

# The Home Screen



When you first connect to eqServer you will be presented with a home screen with a default map.

To the right of the map are icons to access the main functions of eqServer (from top left):

- The red icon accesses **Wave Finder** – a feature that allows you to extract waveform files from the data file archive
- The orange icon accesses **Event Finder** – an SQL query generator that produces event lists from the earthquake database
- The light green icon displays **One Hour** of data from multiple stations – either all stations, or groups of stations as defined by sub-network definitions
- The dark green icon displays **One Day** of data from a single station – a modern day version of the traditional drum recorder
- The light blue icon shows the **Latest Event Report**, an automatically generated bulletin based on triggered data associations. Older reports are also viewable here
- The dark blue icon displays the last hour of **Live Data** from all stations as an image sized to suit a Full HD widescreen display panel, updated every 30 seconds
- The purple “**Stations**” button allows the user to easily view, add, edit, or delete seismic monitoring stations from the database, and the pink “**Settings**” button will take you to a screen containing the configuration sections of the eqServer system

# Settings

The settings page is used when initially setting up eqServer and to modify notification settings, display settings, data sources and other minor parameters. The immediately accessible settings are in the grey boxes with the red title bars. If you edit any of these boxes, click the Save button before changing any other settings boxes.

## ***Server Title***

This is the title that will appear above the map on the home screen when you first log in to eqServer.

## ***Data Age (hours)***

The map on the home screen shows the location of the stations that you have selected to send data to eqServer. Two symbols are available to categorise stations, each with different time frames to colourise the symbols to indicate the age of the latest data to arrive. We typically use circles to indicate data from stations that are sending in data continuously, and triangles for stations that only send in triggered event data. Based on the default values, if eqServer has received data from a continuous station within the last 0.6 hours, it is displayed as green, otherwise it will be displayed as yellow (as a warning that there maybe a telemetry issue), and if it has not sent data in for more than 75 hours the circle turns red (indicating that some action is needed for this station). These values can be set to whatever time period is appropriate for your situation.

Similarly, for triggered (triangle) stations, we expect data to be sent in at least once a day, so the symbol turns yellow after 25 hours without any data, and turns red after 150 hours to indicate it has been almost a week since data was received from the station. Some recorders, such as the Kelunji Echo and EchoPro, can be set to send a state-of-health message every so often so that eqServer knows that all is OK, otherwise you will be relying on event triggering to keep the symbols green. Again, these time periods can be changed to suit your application.

The symbols can be used to categorise your stations in various ways. For example, you may wish to use the circle and triangle to categorise stations as cellular versus satellite telemetry, broadband versus short-period sensors, strong motion versus weak motion stations, structural monitoring versus free field instruments, etc.

## ***Auto Location***

eqServer will automatically locate earthquakes to a fixed depth. Enter the typical earthquake depth (in kilometres) for your region in the field provided. It will also use one of many preset earth model files. A generic one that can be used worldwide is "JBMod" which uses the Jeffreys-Bullen time travel tables as the one-dimensional earth model. Please contact the SRC if you would like a custom layered P and S wave travel time model created specifically for your region.

## ***Database***

This section deals with the SQL database that has been installed on the eqServer computer. **These settings should not be changed** unless you are an Advanced User and have installed an additional database on the eqServer system with a different name/user/pass.

## ***Email Alerts***

### ***Mail Settings***

You will be able to set your sub-networks to analyse incoming data for events, which will generate event bulletins and email notifications. eqServer needs to send email through a mail server. Enter your SMTP mail server address, sender email and password (if required) into the appropriate fields, ensuring your mail server accepts connections from the network upon which your eqServer is located. If you are using a Gmail account for sending alerts, simply type in "gmail" in the Server section and enter your Gmail address and password.

### ***Notification Window***

If you have many sub-networks triggering and a large earthquake occurs, it is likely that multiple sub-networks will generate a notification for the event. Rather than sending one notification for every sub-network that has triggered, eqServer can be told to associate sub-

network events together should they occur within a particular time period. The **Notification Window** defines this time period, which by default is set to 300 seconds. The first sub-network that triggers will send out a notification message, and if any other sub-networks trigger within the 300 second window, they will be gathered and sent as a single notification at the end of this period. If you set this to a very small number (e.g. 1), each sub-network send out its own notification message, which means you will potentially receive several notifications for each large event, which could have a cost implication if you are using an email-to-SMS service to multiple recipients.

### ***Recipients***

You can define any number of email recipients for event notifications. There are three styles of notification message: SMS, Email, and Message. The SMS format is compact and designed for feature phones. The Email is a long form report with lots of calculation details with a link to the online report. The Message format is a compacted SMS for smart phones that just lists the time, location and magnitude, along with a link to the latest online report.

Enter the recipient's email address, using the comment field for your own purposes. If you don't want to receive alerts for events that are older than some number of hours, tick the "No Old" box for that user and specify the number of hours. This is useful to avoid notifications from automatic relocations of events when data from stations that have been offline for some time come back online.

The rest of this line shows all of the defined sub-networks. Tick the box under each sub-network to enable notifications to that recipient for alerts generated by those sub-networks.

Click the green "+" icon to add another recipient.

### ***Forward Incoming Files to Another FTP Site***

Some seismographs will send their data in to eqServer via FTP. These FTP login details and other technical details related to your eqServer will be provided to you upon delivery.

Triggered "**Event Files**" should be sent in to *my.eqserver.com/trig/in*

"**Continuous Files**" are sent in to *my.eqserver.com/cont/in*

A copy of these files can then be forwarded onto another FTP site (perhaps another eqServer, or a backup data repository). Simply enter the destination FTP site credentials and tick "All" to send data from all incoming stations to the destination, or enter the station codes of the data files that you wish to forward to another FTP site, with each code (case sensitive) separated by a space.

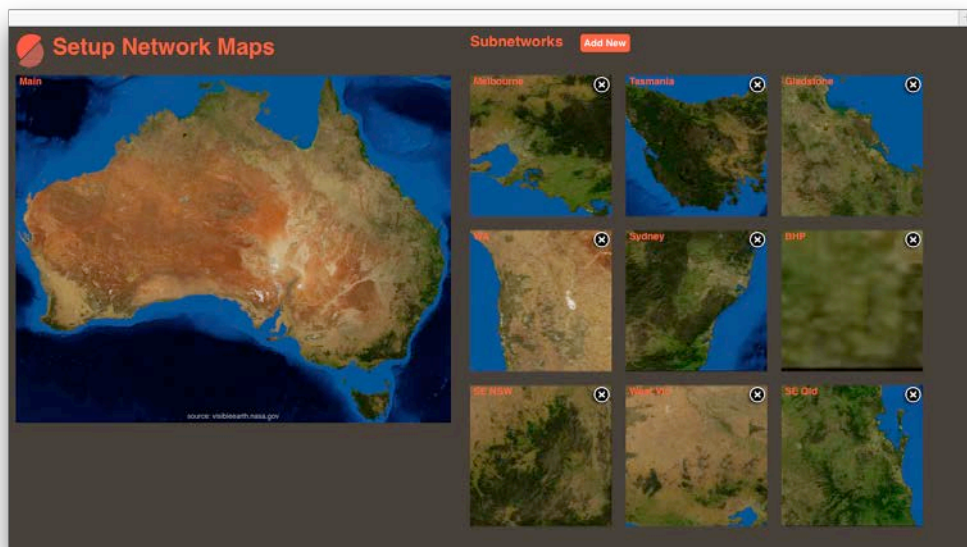
Click the green "+" icon to add another FTP destination.



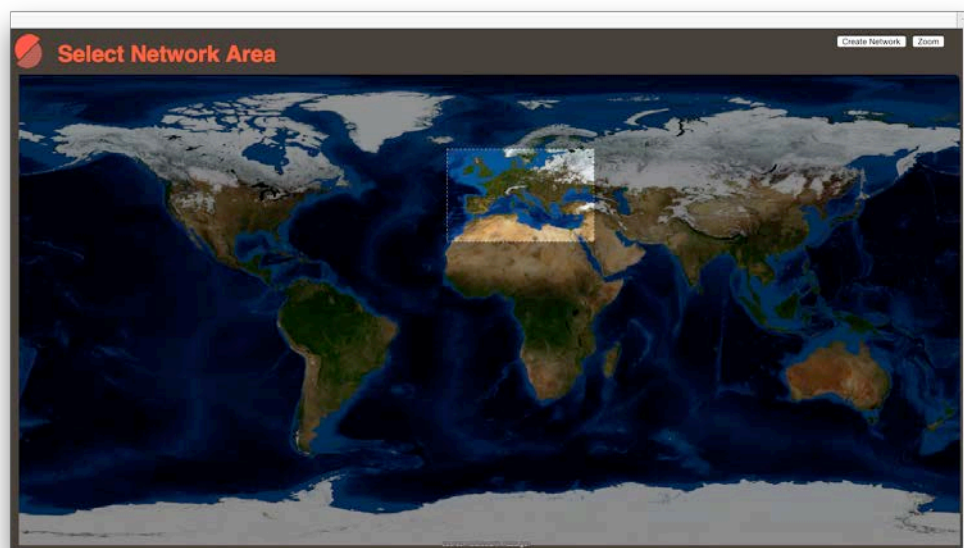
# Maps & Networks



The home page of eqServer shows you the Main map as defined on the Maps & Networks settings page. This is the map area that encompasses all of the stations you expect to receive data from into eqServer. When you click on the **Maps & Networks** settings icon, the current Main map is shown on the left side of the screen, and any sub-networks you have defined within this main map are shown on the right side of the screen.



To define a new **Main map**, click anywhere on the current Main map image and you will be presented with a map of the world. Click and drag a box\* to define an area on the map.



*\*Note that this function may not be available on touch-based input devices such as smart phones and tablets.*

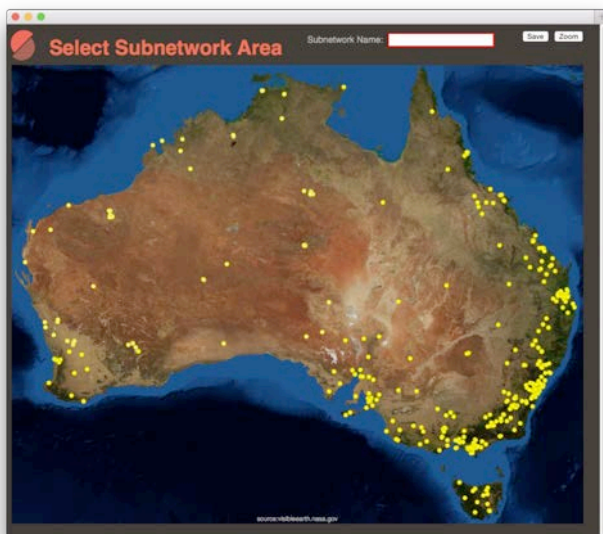


You can now click on "Create Network" to use this as your Main map, or click on "Zoom" to load a more detailed map of this area so that you can select more accurate map boundaries. If you have zoomed in you can continue to zoom, or create your network map.



## ***Add a Sub-network***

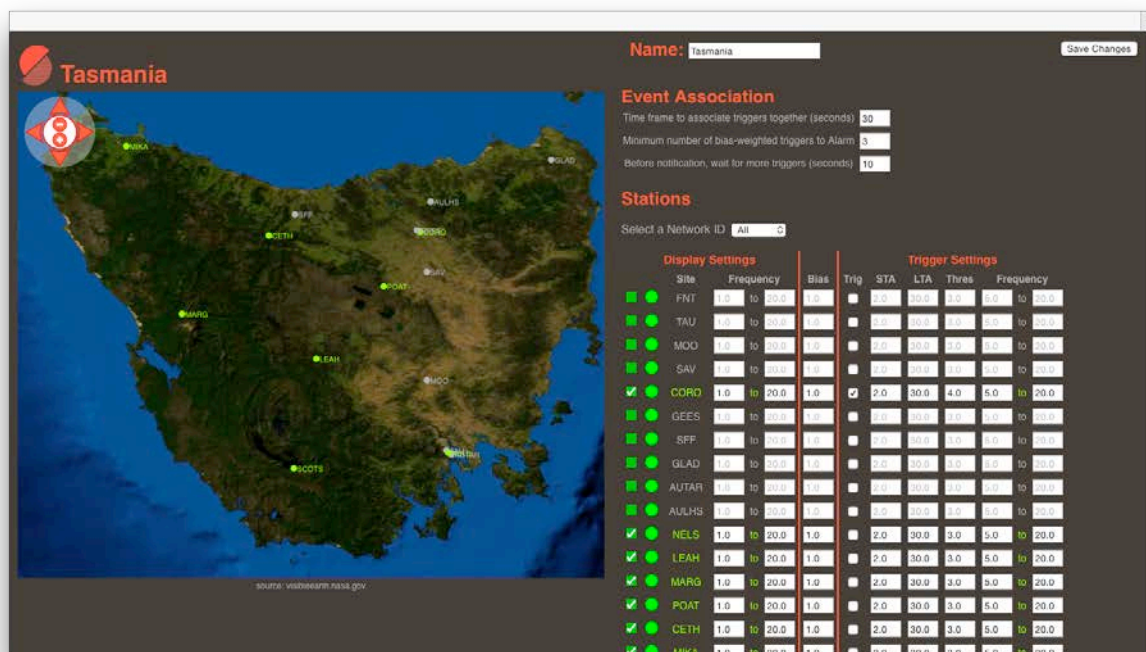
Once you have defined your Main map, you can start to define your **Subnetworks** so that you can generate automatic earthquake locations by station association. You may only wish to have a single sub-network to start with, and you can add more later as your network expands. Click on the "Add New" button next to the Subnetworks title.



Your Main map will now load, showing yellow dots wherever there is a **Station** defined in the database to help guide your sub-network boundaries.

You must type in a **Subnetwork Name** before proceeding. You can then drag a box on the map to define the boundary (or a zoom box) as you did for the Main map.

When you are happy with your selection, click Save to proceed to the detailed settings for your sub-network.



All of the stations that are in the database that fall within the sub-network boundary will be shown on the map as grey dots and in a list on the right side of the screen. As you mouse-over the stations in the list they will be highlighted in the map, and vice versa. Click on a station on the map (or tick the box in the list ) to add it to your sub-network. You can filter the list of stations displayed based on their Network ID using the drop-down menu at the top of the list. You can also click on the circle symbol in the list to change it to a triangle symbol so that it uses the alternate data age symbol on the state-of-health map.

## Display Settings

When you view data using the **One Hour** display function for this sub-network, you can choose to filter the data to a particular frequency band to make certain events display more clearly. The display function automatically scales the data so that the average signal for the hour is just visible, but for broadband sensors this average level can be quite high over this period, so it may be difficult to see earthquakes above the average signal level. If you are using broadband sensors but you wish to clearly see local earthquakes on One Hour, we recommend setting the Frequency range as 2 to 20 Hz.

## Bias

When defining the number of stations that need to trigger within a particular time window to declare an event, you may wish to bias a station to have a greater or lesser impact on the event association routine. If a station is particularly quiet and only ever triggers on "real" events, you may wish to give it a weighting of 1.5 or 2.0, but if a station is particularly susceptible to local noise you may wish to set the bias to 0.3 or 0.5.

## Trigger Settings

If you have stations sending continuous data into eqServer (e.g. from a SeedLink stream or a Kelunji Gecko) you will need to run an algorithm over the data to generate an event trigger. If the station you have enabled is a continuous stream, you can tick the “Trig” box and set STA/LTA, Threshold, and Frequency pass band settings to set the trigger sensitivity. There is a detailed explanation of STA/LTA triggering routine in the eqWave user manual.

## Event Association

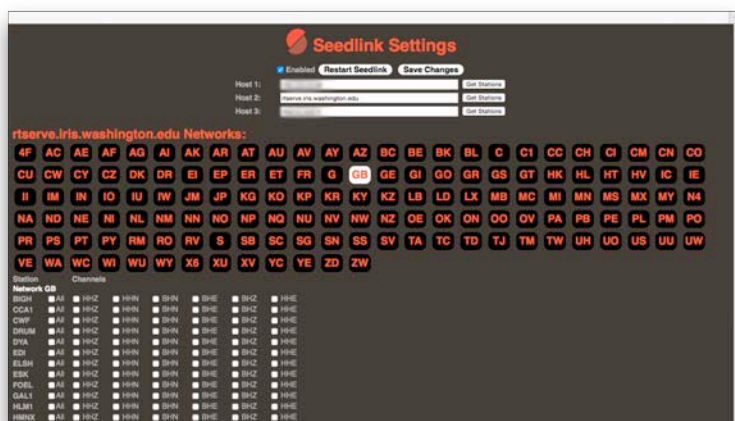
To declare an “Event”, eqServer is looking for multiple triggers to occur within a timeframe. The size of this time window will depend on the size of your network and earthquake wave travel times, but as a rule of thumb you can set it as 10 seconds for every degree across your network.

The minimum number of stations that is usually required to reasonably attempt an earthquake location is 3, but if you have a high density of stations you may wish to increase this to a higher number to reduce false triggers. The Bias of the station (defined earlier) will contribute to this Alarm threshold.

After declaring an Event, you may want eqServer to wait for some time before calculating the location and magnitude to allow data from additional stations to come in. This wait time is defined in seconds and is set in the last settings field in the Event Association section.

Remember to click on the “**Save Changes**” button at the top right corner of the page to save your sub-network settings.

## SeedLink





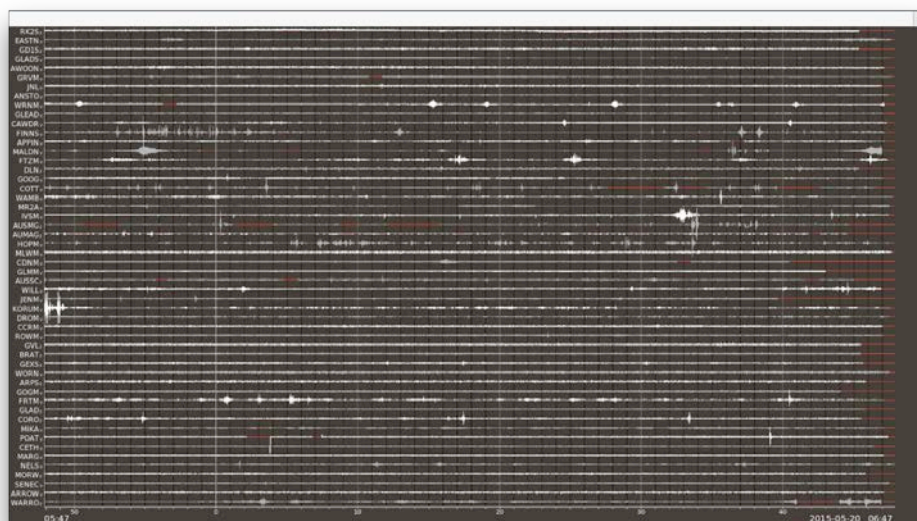
# Live Data Sorting

Much like the Subnetwork display settings for One Hour, you can define frequency display for the Live Data display. You can also manually sort the order that the stations are displayed, and you can also choose which of the incoming channels to display on Live Data.



Station	Channels to Display	sps	Filter (Hz)
RK2S	<input checked="" type="checkbox"/> SHZ	20	<input type="text"/> to <input type="text"/>
EASTN	<input type="checkbox"/> East T <input checked="" type="checkbox"/> Up T	100	<input type="text"/> to <input type="text"/>
GD1S	<input checked="" type="checkbox"/> SHZ	20	<input type="text"/> to <input type="text"/>
GLADS	<input type="checkbox"/> East T <input checked="" type="checkbox"/> Up T	100	<input type="text"/> to <input type="text"/>
AWOON	<input type="checkbox"/> East T <input checked="" type="checkbox"/> Up T	100	<input type="text"/> to <input type="text"/>
RIV	<input type="checkbox"/> BHE	40	<input type="text"/> to <input type="text"/>
GRVM	<input checked="" type="checkbox"/> c03	100	<input type="text"/> to <input type="text"/>
JNL	<input checked="" type="checkbox"/> c03	100	<input type="text"/> to <input type="text"/>
ANSTO	<input checked="" type="checkbox"/> c03	100	<input type="text"/> to <input type="text"/>
WRNM	<input checked="" type="checkbox"/> c03	100	<input type="text"/> to <input type="text"/>
GLEAD	<input checked="" type="checkbox"/> c03	250	<input type="text"/> to <input type="text"/>
CAWDR	<input checked="" type="checkbox"/> c03	250	<input type="text"/> to <input type="text"/>
FINNS	<input checked="" type="checkbox"/> c03	250	<input type="text"/> to <input type="text"/>
APPIN	<input checked="" type="checkbox"/> c03	250	<input type="text"/> to <input type="text"/>
MALDN	<input checked="" type="checkbox"/> c03	250	<input type="text"/> to <input type="text"/>
FTZM	<input type="checkbox"/> East T <input checked="" type="checkbox"/> Up T	100	<input type="text"/> to <input type="text"/>
DLN	<input checked="" type="checkbox"/> SHZ	20	<input type="text"/> to <input type="text"/>
YNG	<input type="checkbox"/> BHN	40	<input type="text"/> 2 to <input type="text"/> 20
GOOG	<input checked="" type="checkbox"/> c03	100	<input type="text"/> to <input type="text"/>

To change the order of the stations, place your cursor over a station and it will become highlighted. Click and drag the station up or down in the list to set the display order. Turn off any channels that you do not wish to display, and set the frequency pass band of the data to be displayed on the Live Data screen.



Scroll to the bottom of the screen and click the **"Save"** button and within a few minutes your Live Data screen will refresh with the updated display settings.

# Places

The default eqServer SQL database is populated with a list of place names (cities, towns, lakes, etc) but you will probably need to add more detail for your map regions. You can export a list of place names, add a new place, edit a place name, or delete places from the database.

The screenshot shows a web application titled "Places" with a dark background. It features four distinct colored sections for different functions:

- List (Red Section):** Contains search criteria for listing places. Fields include "List places between :", "Lat" (-90), "Long" (-180), "and :", "Lat" (90), "Long" (180), "where :", "Name contains :", "Region contains :", "Country contains :", and "Minimum Size : 7 - Mining". A "List" button is on the right.
- Add (Yellow Section):** Used for adding new places. Fields include "Add New Place :", "Lat" (-37.45), "Long" (144.58), "Name :", "Region :", "Country :", and "Minimum Size : 7 - Mining". An "Add" button is on the right.
- Edit (Orange Section):** Used for editing existing places. Fields include "Edit Site where:", "Name contains :", "Region contains :", and "Country contains :". An "Edit" button is on the right.
- Delete (Green Section):** Used for deleting places. Fields include "Delete Site where:", "Name is :", "Region is :", and "Country is :". A "Delete" button is on the right.

Below the Delete section, there is a note: "Enter complete Name, Region & Country Deleted Immediately."

The first (red) section will extract a list of place names from the database. You can set the boundaries of the extraction using latitudes and longitudes, or where the entry contains a particular word in the name, region, or country. Places have a defined "size" hierarchy, and the list can be set to only show places above a certain size. A page will load after you click the "List" button. You can select all, copy and then paste the results into Excel if required.

To add a new place name to the database, define its coordinates, name, region, country and category in the yellow section, then click on the "Add" button.

If you wish to edit a site, type partial text into as many fields as possible to target the intended result. If there are additional entries that match your search field you will see the message "more than 1 row selected", so check that the visible result is the correct entry.

To delete an entry from the place name database, enter the name, region and country as it appears in the List result and click "Delete". This will remove the entry, so check your entry to be certain before clicking the button.

# Stations

We use the term “Stations” to define an earthquake monitoring location, which are sometimes referred to by seismologists and geophysicists as “sites” or “seismographs” or “nodes”. The default database may contain some stations, which you can view and edit in much the same way as described in **Places**.

The screenshot shows a web interface titled "Stations" with a red logo. It contains several forms for managing earthquake monitoring stations:

- List Stations Between:** A search form with fields for Latitude (Lat) and Longitude (Long) with range selectors (e.g., -90 to 90). It also includes a "where" section for text-based searches on Station Code, Operator, Owner, and Location, with a "Find" button.
- Add New Station:** A form with fields for Code, Elevation (km), Latitude, Longitude, Description, Owner, and Operator. It includes "Start" and "End" date fields for Operating Dates and an "Add" button.
- Edit Station:** A form with a station code field and an "Edit" button.
- Delete Station:** A form with a station code field, a confirmation message "Are you sure? (Deleted immediately)", and a "Delete" button.

You can produce a list of stations using latitude and longitude boundaries, station codes and other parameters. Partial text matching will produce results, e.g. using “aust” to search a location description will also list stations described using the terms Australia, Austria, and names such as Faust.

The station code is code of up to five characters made up of letters (typically upper case) and numbers only. The **latitude**, **longitude** and **elevation** are self-explanatory, and the **description** is a human readable text field to help you find stations using relevant keywords. The **owner** of a site may be different to the **operator** of the site, and these are usually short codes that usually relate to the international network code, such a GB for the British Geological Survey or AU for Geoscience Australia.

The **start dates** are useful for historical records, and **end dates** are used to ensure only current stations are plotted on the maps when setting up sub-networks.

To edit or delete station, enter the exact station code, proceeding with caution when deleting a station as the action is immediate and non-reversible.

# Live Data



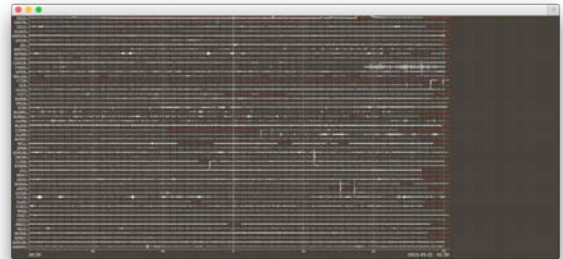
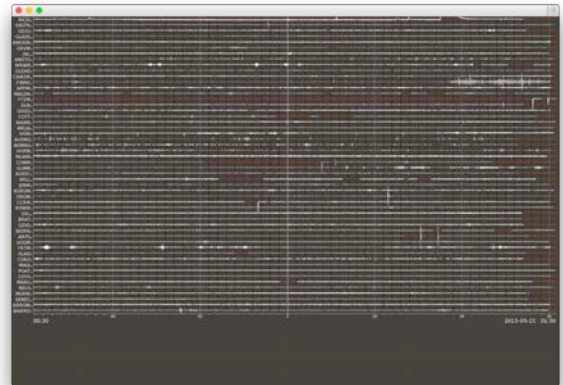
The Live Data display web page displays a high resolution image of the last hour of data received by eqServer. The image is suited to widescreen television displays that have a screen ratio of 16:9, but the image is automatically scaled so that it fits to the browser window resolution.

If your browser window is wider or taller than this ratio you will see a gap at the right or bottom of the image.

Most web browsers have a full screen or presentation mode that will hide the navigation and tool bars so that your screen will only show your seismic data. The Google Chrome browser has a very clean presentation mode that is well suited for showing this page on an LCD television display.

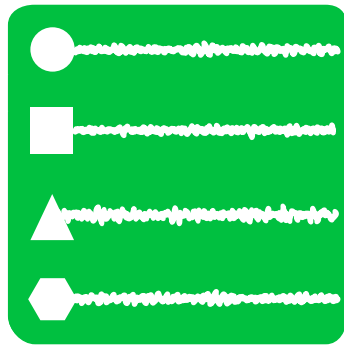
The web page automatically refreshes every 30 seconds.

*To prevent image burn-in we do not recommend the use of plasma displays for Live Data*

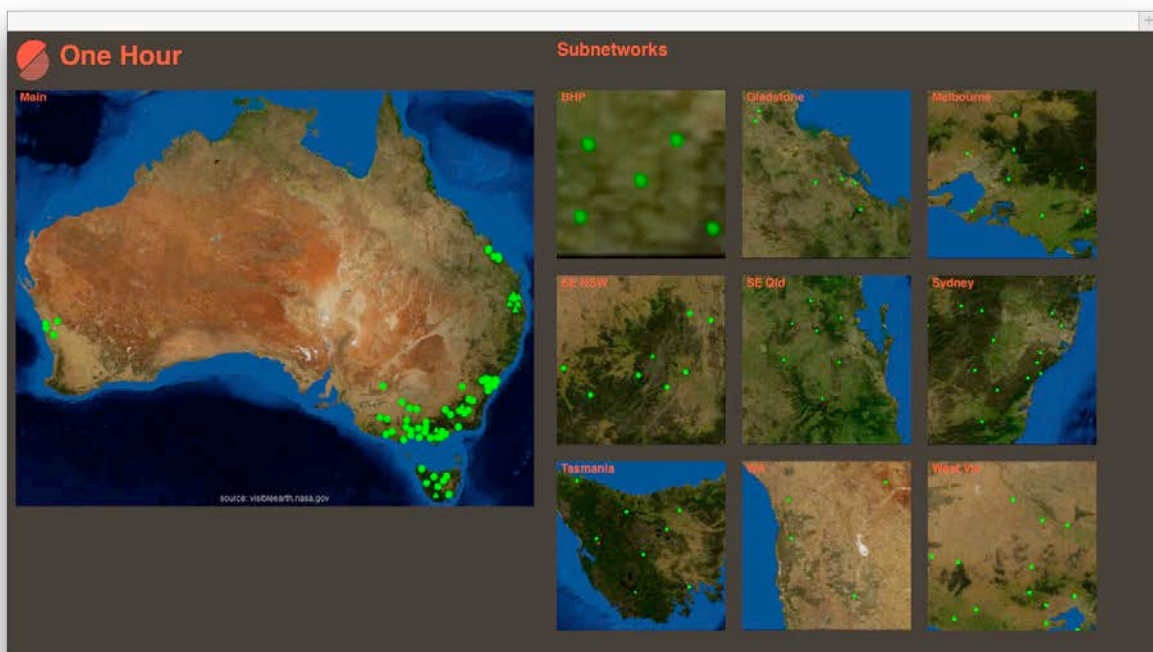




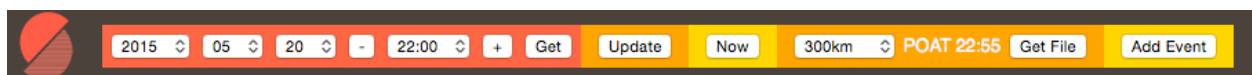
# One Hour



The One Hour display works in a similar way to Live Data in that it shows data from many stations for a one hour period. The difference is that you can browse back in time in one-hour blocks, and you can view subsets of data as defined by your sub-networks. When you first click on the One Hour icon you will be presented with your main map and your sub-network maps. If you click on the main map you will be able to browse data from all stations (similar to Live Data), but by clicking on a sub-network you will only see the continuous data from the stations within the sub-network.



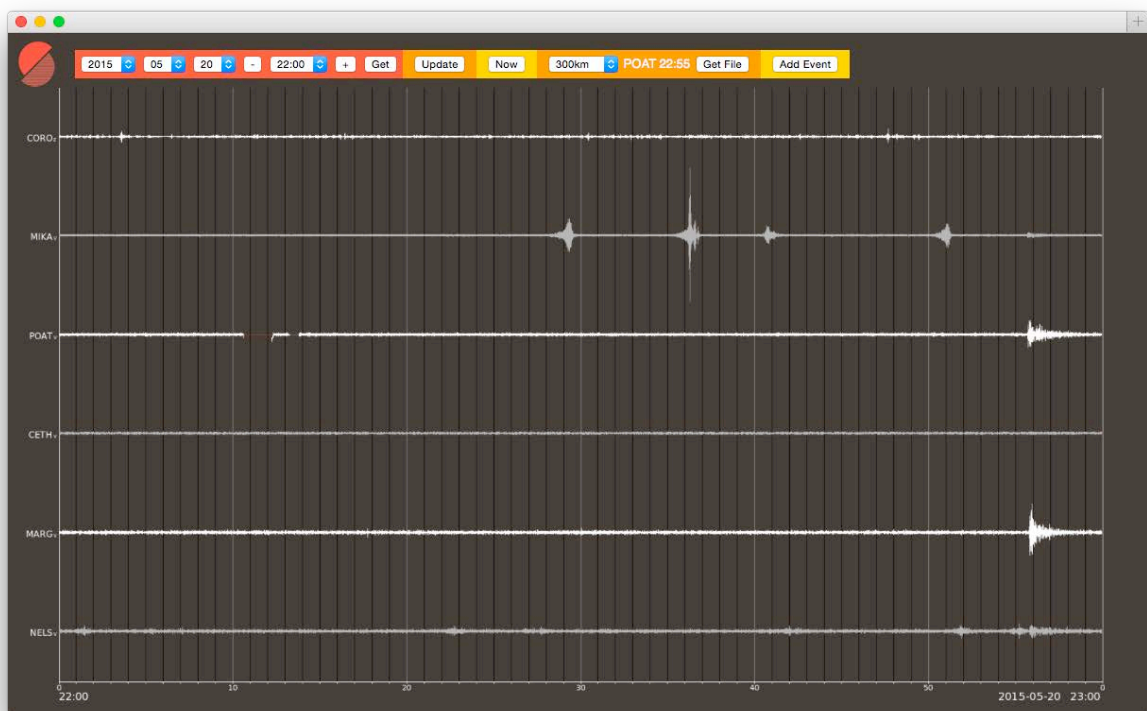
When you click on a map, the screen that is displayed shows the waveforms for the current hour (which may be only partially completed as each page starts on the hour). You will notice a control panel at the top of the screen:



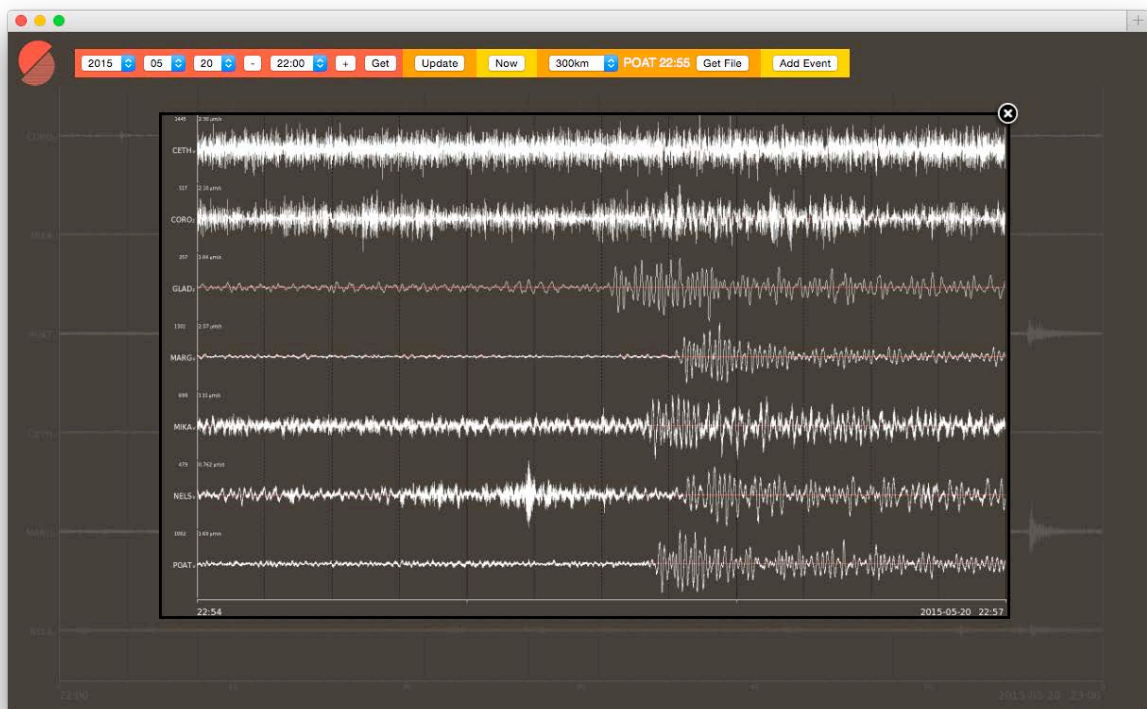
The red Seismology Research Centre "S" logo in the top left corner will always take you back to the home page. In the red section you can use the "minus" and "plus" buttons on either side of the hour menu to step through other hourly images, or you can select a date and time from the menus then click the "Get" button to jump to a particular hour.

These images are generated on demand and stored in a buffer. If you believe additional data has been sent in since the image was last rendered, click the "Update" button.

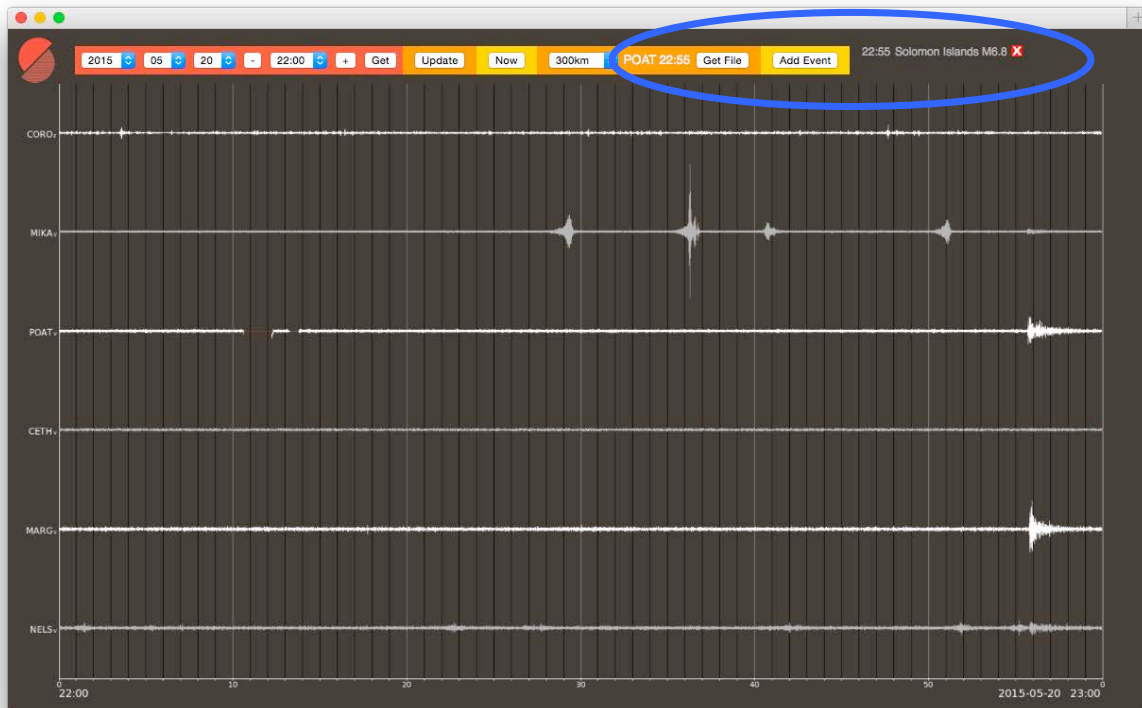
You can quickly jump back to the current hour by clicking on the “Now” button.



If you see a signal of interest (e.g. above, the teleseism near the end of the hour), you can click anywhere on the image and a window will pop up that shows a three-minute zoom of the data from the station you clicked on, and from all stations within 300km of that station.

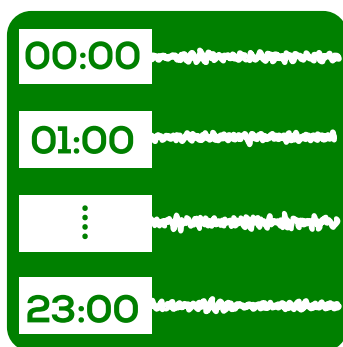


You can then click on the “Get File” button to download the full resolution waveform files to your computer.



You can also add a tag to the time on the event by clicking on the “Add Event” button, which allows you to enter a text description that will appear in the top right of this hour’s One Hour page for future reference (indicated above in blue outline).

## One Day

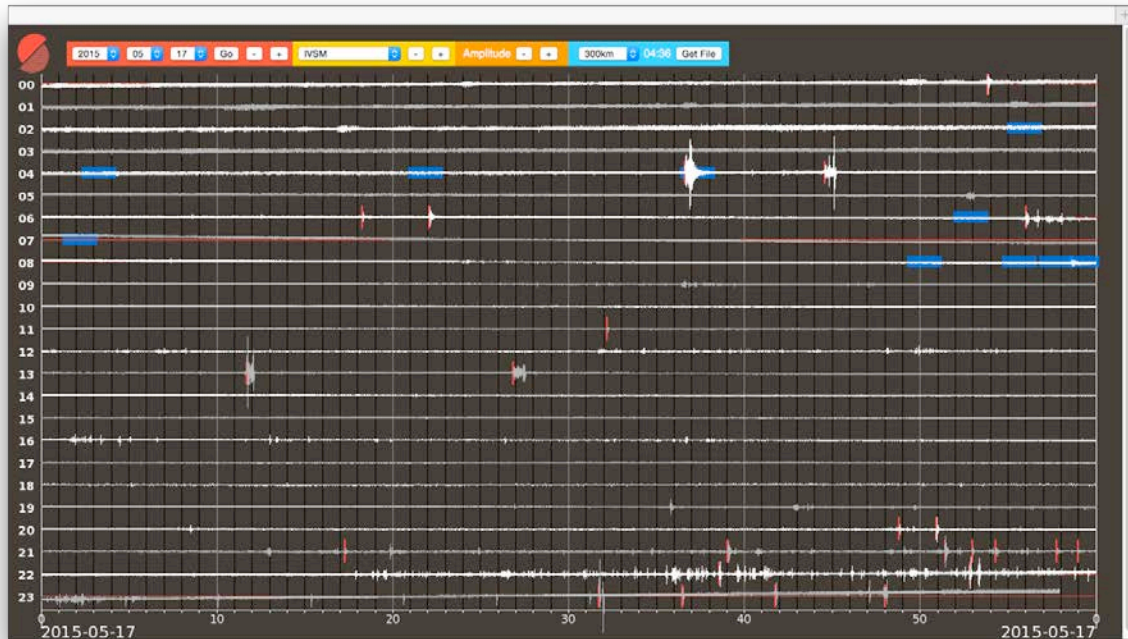


The One Day display works in a similar way to One Hour. It still shows one hour of data per line, but it shows 24 lines of data from a single station. The image is scaled to fit the available screen area in your web browser. The control panel at the top of the screen is slightly different to One Day as you now use the “plus” and “minus” buttons to step through days rather than hours, and you can select which station to view from a list, which is arranged by sub-networks.

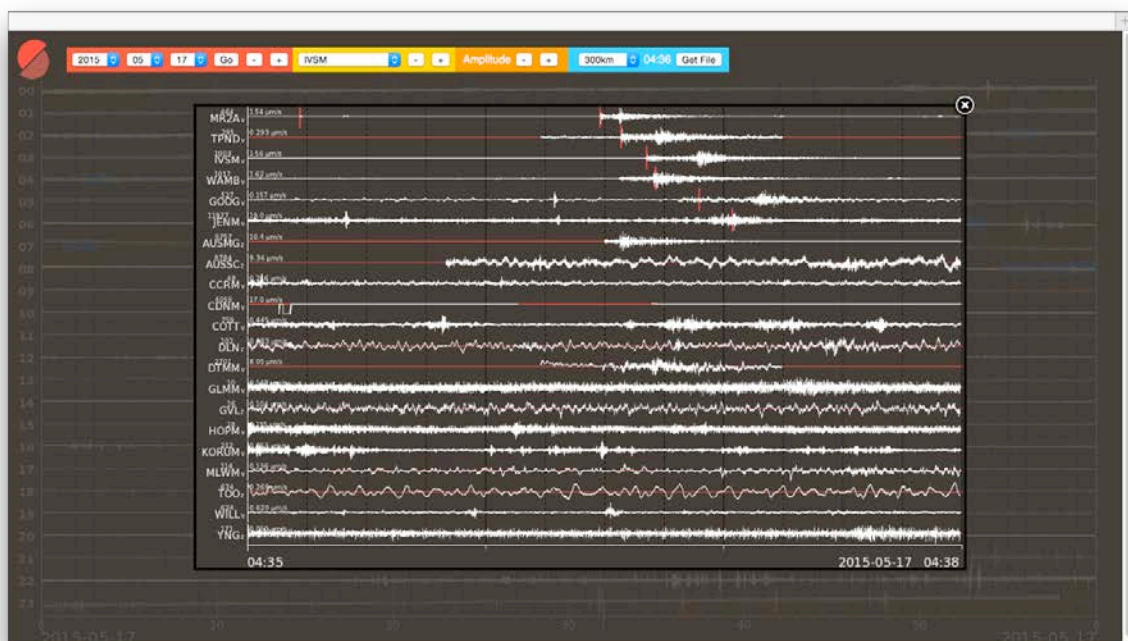


The signal amplitude is scaled based on the average signal level from the first hour of data. If you need more or less amplitude resolution, use the Amplitude – and + buttons in the orange section of the control panel.

The blue markers throughout the day indicate eqServer's automatic event detections on that day, which may or may not involve the station you are viewing. If the station you are viewing triggered during that day you will see a red vertical line at the trigger time.



As with One Hour, you can click on an event of interest and see a pop-up window showing three minutes of data from that station and the data from stations within 300km. Simply click on the "Get File" button to download the waveform files. For the data download you can adjust the number of stations that are downloaded by selecting a distance from the drop-down menu in the blue section – the default being 300km, as per the preview.

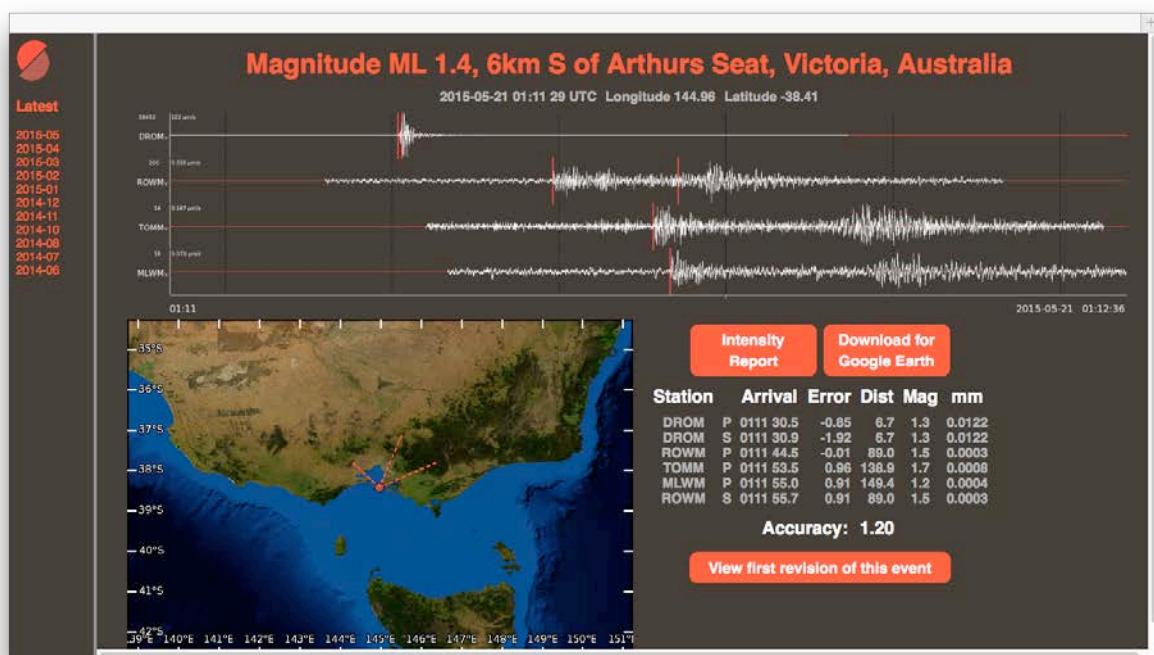




# Latest Event Report



One of the main features of eqServer is its ability to automatically detect earthquakes and send out a notification of the estimated location and magnitude. When an event is declared, a bulletin is generated showing the waveforms, a map of the estimated location, and a summary of the data related to the solution. The latest event report can be accessed by clicking on the blue icon with the epicentral rings, a logo shared with our interactive calculation program, eqFocus.



The estimated magnitude and location of the event is at the top of the screen, followed by the date, time, latitude and longitude of the solution. Below this is an image of the waveforms used in the solution. By clicking on the waveform image you will be taken to the Wave Finder screen, with the date, time, and stations to download automatically entered into the relevant fields. You can adjust these as required, which will be discussed later.

Below the waveforms is a map showing a circle where the automatic solution places the event, with dotted lines connecting it to the location of the stations used in the solution. Clicking on the map will open a new browser window for Google Maps with a pin dropped at the estimated location of the event.

To the right of the map are two buttons and a table with the trigger time and amplitude data from each station. Red text means the data has been deferred from the solution. The **Accuracy** number indicates how well the solution fits with the earth model used.

The **Intensity Report** button will show a brief report that provides distances to nearby locations (from your Places database) as well as an estimate of the Modified Mercalli Intensity at various distances. This uses an attenuation function that applies for SE Australia and California, but may require customisation for regions with different local attenuation.

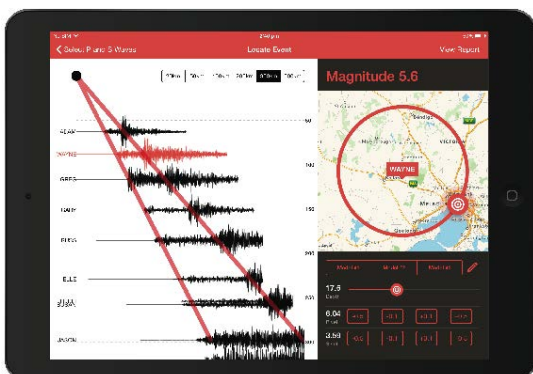
The other button initiates the creation of a KML file to **Download for Google Earth** which you can open with the Google Earth desktop application.

If there have been several revisions of the automatic solution, you will be looking at the latest version. To view the first revision of the event (which may better match the information received in the notification), click on the button below the data table.

On the left of the screen you will see a list of past months. Click on a month to open a second column that shows a list of automatic event bulletins, in reverse chronological order, suffixed by the name of the sub-network that created the bulletin. Click on a bulletin to load it into the main window to the right.



## Quick Quake for iPad



These automatic event bulletins are the source of data for our free Quick Quake iPad app. The app connects to your eqServer to browse recent and past bulletins. You can refine automatic solutions by marking a P & S arrival on a single station and moving the earthquake until it roughly fits the expected wave travel times.

For more information visit [www.src.com.au/software/quick-quake/](http://www.src.com.au/software/quick-quake/)

# Wave Finder



As mentioned in the previous section, Wave Finder is a way to extract waveform files from the archive, based on time and location. Wave Finder can be accessed from the Event Reports by clicking on the waveform preview image, or by clicking on the red waveform icon on the home page. This logo is shared by our eqWave application, which is used to view the downloaded files. Opening Wave Finder from the home screen will populate the red fields with the current UTC date and time, which will be the

start time of the data extraction. Edit these as required to a past date/time. The yellow section defines the number of minutes of data to extract from the start time, and you can optionally only extract the vertical channels of data if you have limited download speed.

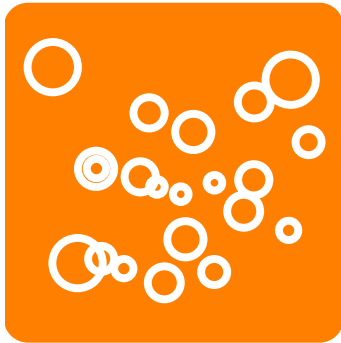
A screenshot of the Wave Finder web interface. The interface is divided into several colored sections: a red header with the 'Wave Finder' logo, a red section for date and time, a yellow section for duration and channel selection, an orange section for station selection, and a green section for file format. The orange section is expanded, showing options for 'Specific Stations' (with a text input and a list of sub-networks), 'Stations near this station' (with radius and site inputs), and 'Stations near this location' (with radius, latitude, and longitude inputs). The green section shows 'SUDS' as the selected file format. At the bottom, there are three buttons: 'Get Waveform', 'Get Image', and 'View Image'.

The orange section tells eqServer which stations to include in the data extraction. You can get data from all available stations; specific stations (by typing in their station codes, separated by spaces, or by clicking on a sub-network button to auto-fill the station codes); from all stations within a certain distance of a particular station code; or from all stations within a certain distance of a particular latitude/longitude.

The last section deals with the data format. If you are using eqWave to view the waveform files, we recommend using the SUDS format so that any available meta data is available for viewing in eqWave. You can alternatively extract the data in MiniSEED format, which is also readable by eqWave. Click on the "Get Waveform" button to download the file, or simply preview or download an image of the files using the other buttons.



# Event Finder



Event Finder is a way to extract a list of events from the database.

By default a filter is set for the "Source Type" to be "L" or "I" to avoid listing automatic solutions, thereby only displaying events that have been refined by a seismologist using eqFocus.

By removing this filter you will then get a text table list of all automatic event solutions.

**Event Finder**

**Find events**

Between 1788 01 01 (yyyy mm dd)

And 2015 5 21 (yyyy mm dd)

**Search area**

Start Lat -37.45 ° Long 144.58 °

Radius 200 km

or

End Lat -37.45 ° Long 144.58 °

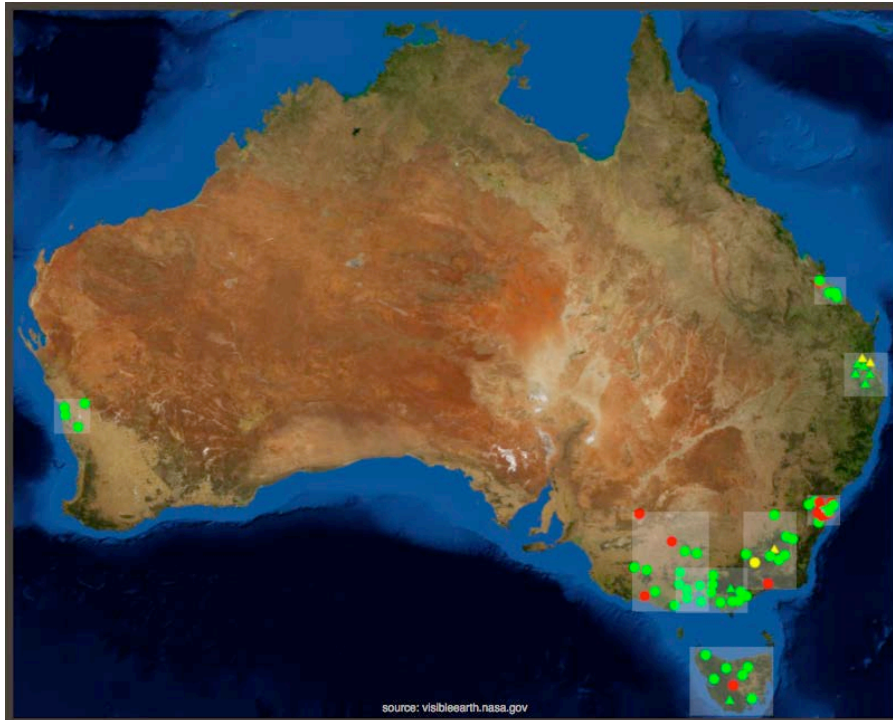
**Filter results**

select filter...	must be between	0 min	0 max
select filter...	must be between	0 min	0 max
select filter...	must not be between	0 min	0 max
source Type	must be	L or	I
select filter...	must be		
select filter...	must not be		

Get Events

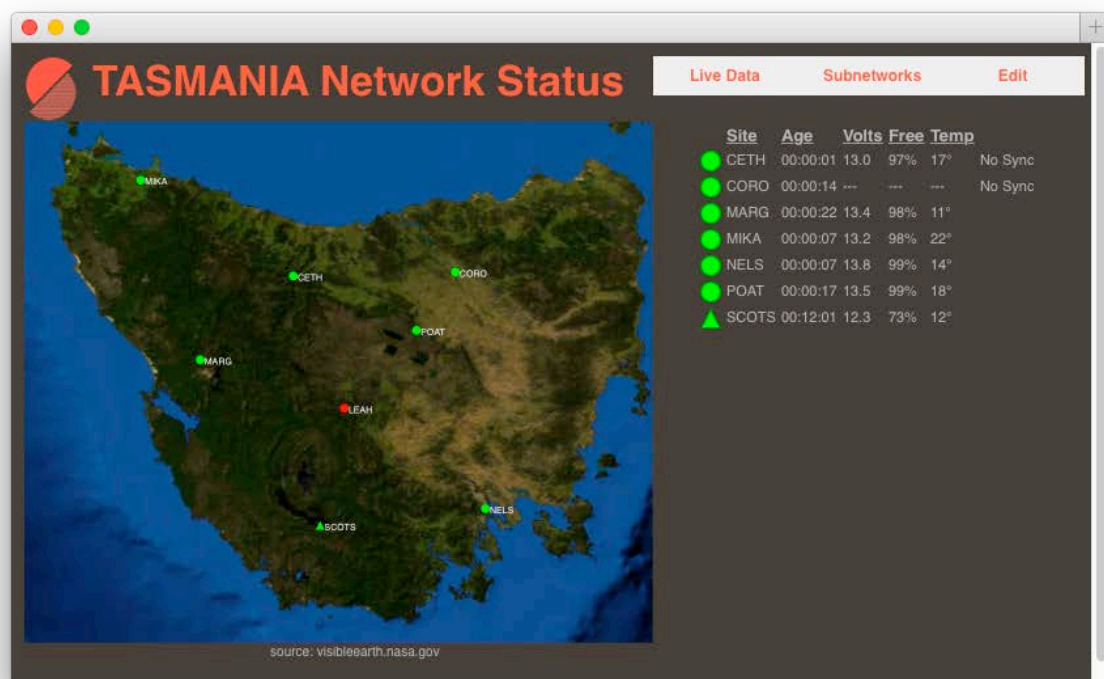
The form is self-explanatory, defining date and distance ranges for the query, with a number of filter options available to reduce the results based on the various parameters stored in the database by eqFocus, as well as by magnitude as stored by eqServer.

# Network Status Maps



Once you have defined your main map area and sub-network maps you will notice that the sub-network areas will be drawn as transparent boxes on the home screen map. Within each of these areas will be markers showing the location of your stations, and their data age as green, yellow, or red circles or triangles.

For a more detailed view of your station status, click on a sub-network area to bring up the Network Status summary page for that sub-network.



Don't worry if your areas overlap and your click brings up the wrong map – you can change to another sub-network from the list of **Subnetworks** that appears at the top of the page.

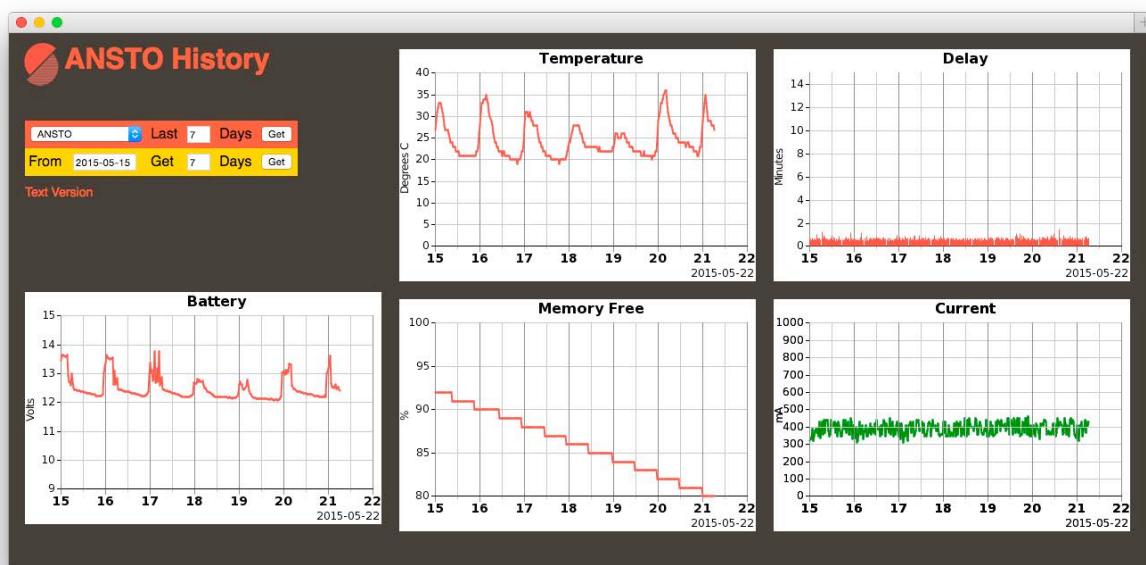
The menu at the top of the screen also contains a link to **Live Data**, which displays the current One Hour page for this sub-network. This page does not automatically refresh, but can be manually updated using your browser controls.

The other menu item allows you to **Edit** the detailed **Settings** for the sub-network (which stations appear on the map, display and trigger settings, event association settings) and edit the **Map**. The latter option will allow you to redefine the boundaries of the map, retaining the settings (stations, display, etc) for the stations that remain within the boundaries of the map.

## Health Graphs

If the seismographs that are sending data into eqServer are also sending station health data, such as battery voltage, temperature, and memory storage remaining (a standard feature of the Kelunji Echo and EchoPro seismographs) then this data is displayed in a table on the right of the screen. Data that comes in from SeedLink servers do not have this meta data and will appear blank. The age of the data is calculated by eqServer. Stations that do send in health data (like the Kelunji Echo and EchoPro) may include GPS synchronisation information – if there is an issue with the GPS a message of “no sync” will be displayed, but this message will also appear if no time synchronisation information is available, as will be the case for SeedLink data. In this case we assume the data is time synchronised.

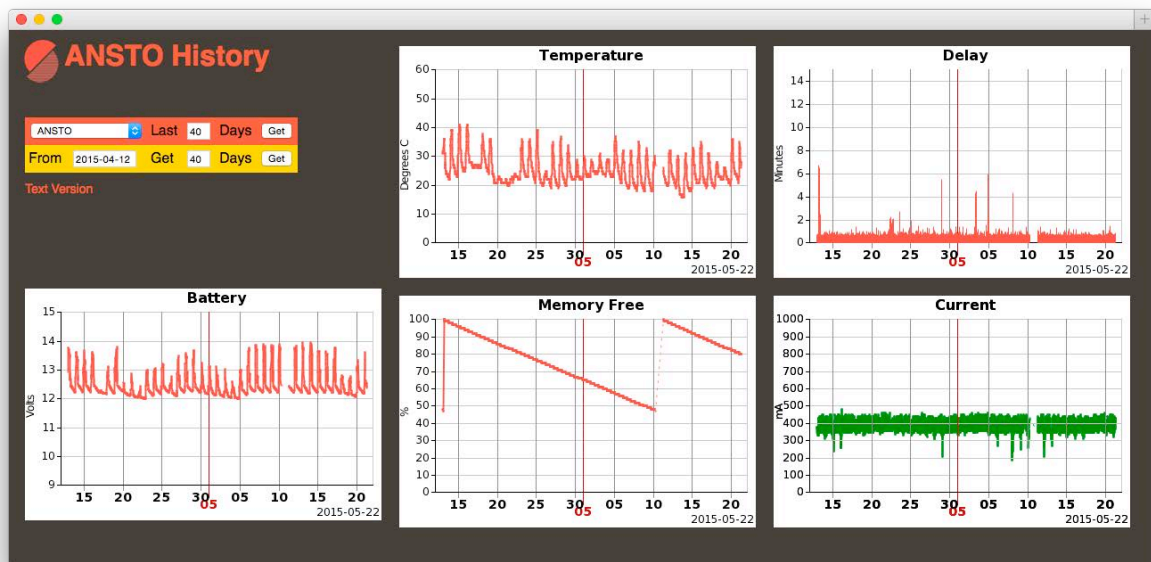
This meta data is being stored in the eqServer database and can provide a useful historical health record for each station. Simply click on the circle/triangle symbol for the station in the list or on the map to bring up the last 7 days of meta data.



Several graphs will be displayed, showing the history of temperature, battery voltage, memory free, telemetry delay, and current consumption of the remote equipment.

Mains-powered stations will usually show a steady voltage, whereas solar panel powered stations (as in the example above) will vary depending on solar exposure. Equipment installed in vaults will have stable temperatures, whereas more exposed installations will vary with ambient temperatures. The telemetry delay is calculated based on the start time of the file that was received compared to the time it was received, which in the case above is around one minute as this recorder sends data files every minute.

You can use the control panel in the top left of the screen to view the health graphs for other stations, for longer periods back from the current date, or from a particular date for a number of days. These long term trends can be useful in diagnosing issues such as solar panel damage or degradation, extreme temperature effects, memory issues, changes in cellular data reception, etc.



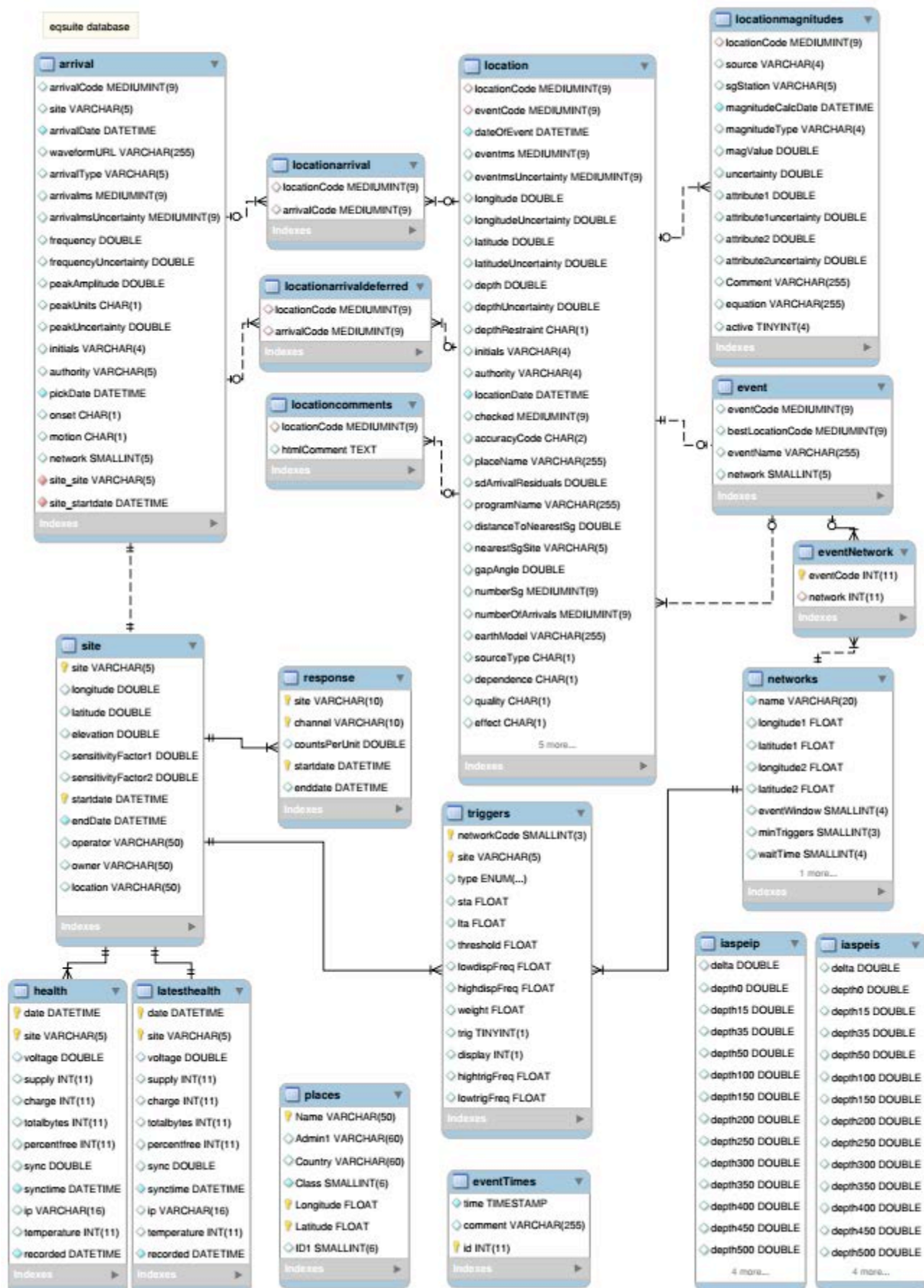
This data can also be exported as a text table using the link below the control panel.

## The eqServer SQL Database

The eqServer data management system uses an SQL database to store all data apart from waveform files, which are stored in a file hierarchy that is used by Wave Finder to facilitate simple data retrieval.

Advanced users may wish to connect to the eqServer database from other systems, and the credentials for access will be provided with the delivery of the system. The details of the database tables are provided on the following pages.





# Introduction

The eqSuite Database stores information on earthquakes and the seismographs used to locate them.

It is used by the eqServer website, the automatic location system programs eqLogger and eqWatch, and in the programs eqFocus and QuickQuake.

## A Basic Definition of Terms

A single earthquake is defined as a single row in the **Event** table.

An **Event** can be located automatically by eqWatch, and also by Seismologists using the programs eqFocus or QuickQuake. Each **Event** will have one or more **Location** revisions, each stored as a row in the **Location** table. The preferred Location will be declared as the **Best Location**, which will be displayed in lists of earthquakes.

Each **Location** may contain multiple **Arrivals** with P, S or other Arrival codes.

The **Arrival** is associated with the seismograph **Site** where it was detected.

Each Location may contain multiple **Magnitudes**.

They may be of different magnitude types, such as ML or MB.

Each **Magnitude** is associated with a seismograph **Site**.

A final magnitude for the Location is usually calculated as an average of all Magnitudes of the same type, or set by the user.

Each **Arrival** and **Magnitude** has an associated Seismograph **Site**.

A **Site** has a geographic location and an owner.

Each Seismograph at a **Site** can regularly send its current State of **Health**.

This includes the state of the battery, temperature and how full its storage is.

The history of the Seismograph Health is stored for a year in the **Health** table.

The most recent health information is stored in the **LatestHealth** table.

Each Seismograph at a **Site** will have one or more waveform Channels which produce waveform files. To convert the data in these files into usable natural values, we need **Response** information.

Sometimes this information is in the file, but in MiniSeed format files it can be stored in the **Response** table.

# Tables

## TABLE `event`

`eventCode` mediumint(9)	Unique ID for this event
`bestLocationCode` mediumint(9)	ID of chosen best Location
`eventName` varchar(255)	A name for this event. Usually the nearest town.
`network` smallint(5)	ID of seismograph network that detected this event.

## TABLE `eventNetwork`

`eventCode` int(11)	Unique ID of an event
`network` int(11)	Unique ID of a network

## Associate Events with Networks

## TABLE `networks`

`name` varchar(20)	A name for the network
`longitude1` float	The bounding rectangle.
`latitude1` float	
`longitude2` float	
`latitude2` float	
`eventWindow` smallint(4)	Seconds that arrivals must occur within to be in the same event.
`minTriggers` smallint(3)	Number of arrivals needed to declare an event.
`waitTime` smallint(4)	Delay before processing event. To allow more arrivals to arrive.
`networkCode` smallint(3)	Unique ID

## A geographic region containing seismographs

## TABLE `location`

`locationCode` mediumint(9)	Unique ID
`eventCode` mediumint(9)	ID of event this location belongs to
`dateOfEvent` datetime	Date and Time to the second the event occurred
`eventms` mediumint(9)	Millisecond of the second the event occurred
`eventmsUncertainty` mediumint(9)	Uncertainty of event time in milliseconds
`longitude` double	Longitude
`longitudeUncertainty` double	Longitude uncertainty
`latitude` double	Latitude
`latitudeUncertainty` double	Latitude uncertainty
`depth` double	Depth
`depthUncertainty` double	Depth uncertainty
`depthRestraint` char(1)	The control on depth when locating. Not used.
`initials` varchar(4)	Initials of person who located the event.
`authority` varchar(4)	Short code of organisation that located the event.
`locationDate` datetime	Date this location was performed
`checked` mediumint(9)	Has the location been checked by another person. Not Used.
`accuracyCode` char(2)	1 or 2 character code describing the quality of the location.
`placeName` varchar(255)	Name of nearest Town.
`sdArrivalResiduals` double	standard deviation of Arrival Residuals
`programName` varchar(255)	The program that was used to determine this Location
`distanceToNearestSg` double	Distance to nearest seismograph site
`nearestSgSite` varchar(5)	Sitecode of nearest site
`gapAngle` double	Maximum angle separating 2 seismographs
`numberSg` mediumint(9)	Number of sites used in location
`numberOfArrivals` mediumint(9)	Number of arrivals used in location
`earthModel` varchar(255)	File used that describe wave velocity in earth layers
`sourceType` char(1)	Local, Blast, Teleseism, Coal, etc
`dependence` char(1)	Foreshock, Mainshock Aftershock, Swarm
`quality` char(1)	Initial, Learner, Automatic, Complete, Reviewed
`effect` char(1)	None, Felt, Injuries, Damage, Surface faulting
`revision` mediumint(9)	The number of times this event has been revised.
`localTimeOffset` double	Local Timezone offset.
`locationMagnitude` double	User chosen magnitude
`locationMagnitudeType` varchar(4)	Magnitude type. ML, MB, MS etc
`maximumObservedIntensity` double	not used.

## A calculated location of an Event



**TABLE `locationarrival`**  
`locationCode` mediumint(9)  
`arrivalCode` mediumint(9)

**Associate Arrivals with Locations**  
Location ID  
Arrival ID

**TABLE `locationarrivaldeferred`**  
`locationCode` mediumint(9)  
`arrivalCode` mediumint(9)

**Deferred Arrivals in Locations**

**TABLE `locationcomments`**  
`locationCode` mediumint(9)  
`htmlComment` text

**Comments on Location**

**TABLE `locationmagnitudes`**  
`locationCode` mediumint(9)  
`source` varchar(4)  
`sgStation` varchar(5)  
`magnitudeCalcDate` datetime  
`magnitudeType` varchar(4)  
`magValue` double  
`uncertainty` double  
`attribute1` double  
  
`attribute1uncertainty` double  
`attribute2` double  
`attribute2uncertainty`  
`Comment` varchar(255)  
`equation` varchar(255)  
`active` tinyint(4)

**Magnitude for this location according to a seismograph**  
Location ID  
not used  
Seismograph  
Date this magnitude was determined  
for example "ML", "MB"  
magnitude.  
magnitude uncertainty  
Value depends on Magnitude Type.  
For ML & MS, value = peak amplitude in counts  
For MB, value = duration in seconds  
  
For ML, value = frequency at peak in hz  
  
A comment.  
Equation used to calculate the magnitude  
1 if used by the Location. 0 if determined to be incorrect

**TABLE `arrival`**  
`arrivalCode` mediumint(9)  
`site` varchar(5)  
`arrivalDate` datetime  
`waveformURL` varchar(255)  
`arrivalType` varchar(5)  
`arrivalms` mediumint(9)  
`arrivalmsUncertainty` mediumint(9)  
`frequency` double  
`frequencyUncertainty` double  
`peakAmplitude` double  
`peakUnits` char(1)  
`peakUncertainty` double  
`initials` varchar(4)  
`authority` varchar(5)  
`pickDate` datetime  
`onset` char(1)  
`motion` char(1)  
`network` smallint(5)

UniqueID  
SiteCode of seismograph  
Time of arrival to second  
not used  
Arrival Code. P, S.  
Milliseconds of time of arrival  
Uncertainty of time  
Waveform Hz at Time. Not always set.  
Uncertainty of Frequency  
Peak amplitude near arrival. Not always set  
c = counts, d = mm, v = m/s, a = m/s<sup>2</sup>  
Uncertainty of arrival  
Initials of person or program that determined the arrival  
Organisation that determined the arrival  
Date the arrival was determined  
e = emergent, i = impulsive, w = weak  
`+` or `-'`  
seismograph network this arrival is used in.

**TABLE `health`, `latesthealth`**

`date` datetime  
`site` varchar(5)  
`voltage` double  
`supply` int(11)  
`charge` int(11)  
`totalbytes` int(11)  
`percentfree` int(11)  
`sync` double  
`synctime` datetime  
`ip` varchar(16)  
`temperature` int(11)  
`recorded` datetime

**State of Health of Sites**

Date and time the health value is received by eqServer  
Seismograph code  
Power supply voltage  
Supply Milliamps  
Charge Milliamps  
Storage in bytes  
% free storage.  
Time adjustment.  
Time Sync was determined  
Internet IP address  
Internal temperature  
Time State of Health values determined

**TABLE `places`**

`name` varchar(50)  
`admin1` varchar(60)  
`country` varchar(60)  
`Class` smallint(6)  
1=national capital  
2= regional capital  
3 = large town  
4 = small town  
`longitude` float  
`latitude` float

**Cities, Towns, Mines**

Name of the place  
Region the place is in  
Country the place is in  
Size of the place.

Geographic location

**TABLE `response`**

`site` varchar(10)  
`channel` varchar(10)  
`countsPerUnit` double  
`startdate` datetime  
`enddate` datetime

**Counts To Units conversion.**

Used when waveform file format does not store response  
Seismograph code  
Seismograph channel  
Conversion value  
Timespan this value applies to

**TABLE `site`**

`site` varchar(5)  
`longitude` double  
`latitude` double  
`elevation` double  
`sensitivityFactor1` double  
`sensitivityFactor2` double  
`startdate` datetime  
`endDate` datetime  
`operator` varchar(50)  
`owner` varchar(50)  
`location` varchar(50)

**Seismograph Site**

Seismograph code  
Geographic location

Elevation on km

Installation date

Shutdown date

Code of organisation that maintains the site

Code for organisation that owns the site

Name of the site.

**TABLE `triggers`**

and triggering on a site

`networkCode` smallint(3)  
`site` varchar(5)  
`type` enum('continuous','triggered')  
`sta`  
`lta`  
`threshold`  
`lowdispFreq`  
`highdispFreq`  
`weight` float  
`trig` tinyint(1)  
`display` int(1)  
`lowtrigFreq` float unsigned  
`hightrigFreq` float unsigned

**eqServer rules for displaying waveform**

Network ID

Site code

Is incoming waveforms continuous or triggered

Short term average seconds

Long Term average seconds

Declare trigger when STA/LTA > threshold

Low Pass frequency filter for display

High Pass frequency filter for display

Value when adding up network.minTriggers to declare event

Do we monitor for triggers with this site?

Do we display this site?

Low Pass freq filter to wave for triggering using STA/LTA

High Pass freq filter to wave for triggering using STA/LTA

# File Archive

Incoming waveform files are stored in either a Continuous, or Triggered file archive.

The general directory structure of the **Continuous** File Archive is

```
/data/repository/archive/SITE/YEAR/MONTH/DAY/YYYY-MM-DD HHMM SS SITE.dmx.gz
```

for example:

```
/data/repository/archive/MLWM/continuous/2015/05/20/2015-05-20 0156 26 MLWM.dmx.gz
```

The Triggered file archive stores files containing arrivals.

The general directory structure for the **Triggered** File Archive is

```
/data/repository/trigarchive/YEAR/MONTH/DAY/YYYY-MM-DD HHMM SS SITE.dmx.gz
```

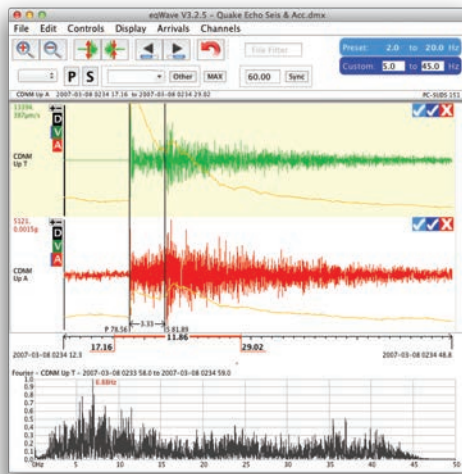
for example:

```
/data/repository/trigarchive/2015/05/20/2015-05-20 0202 40 WRNM.dmx.gz
```



SEISMOLOGY  
RESEARCH  
CENTRE

# Other SRC Software Products

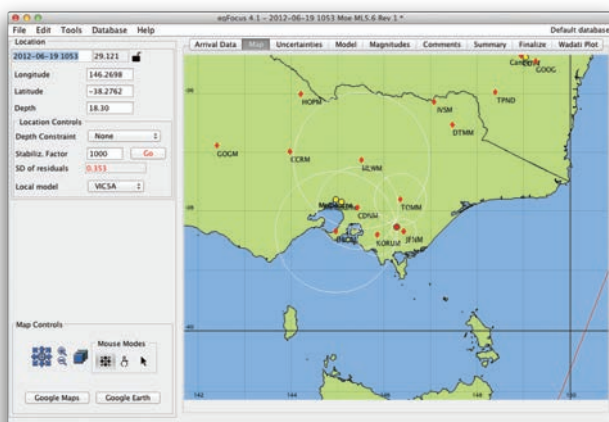
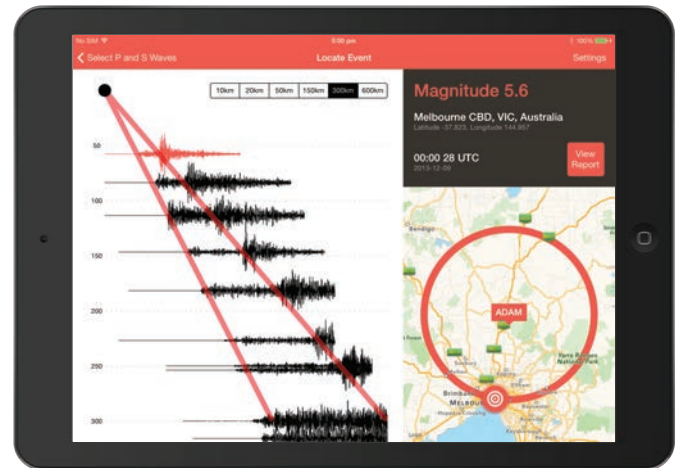


## eqWave

**eqWave** is provided free with the purchase of eqServer, eqFocus, or any Kelunji seismic recorder. It is the most user-friendly earthquake waveform analysis tool in the world, allowing you to easily pick arrivals, filter data, convert between displacement, velocity and acceleration, view frequency spectra, and even estimate local Richter earthquake magnitudes.

## Quick Quake for iPad

**Quick Quake** is the SRC's free iPad app that can access eqServer earthquake alert bulletins, and allows users to manually locate earthquakes using a totally new and extremely simple method. **Download it today for free from the iPad App Store** and use the demo data to see how easy it is!



## eqFocus

**eqFocus** is the perfect partner to eqWave and eqServer.

With data from three or more seismograph stations you can pass arrival times and amplitudes from eqWave to eqFocus and let it do the location and magnitude calculations for you.

You can customise earth models, enter your own place names and station response information, view earthquakes in Google Earth or Maps, and more.